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DR. WILLIAM J. MORTON

Chairman of the Electro-Therapeutic Section of the International Electrical Congress, 1904.

THE AMERICAN
X-RAY JOURNAL
Devoted to Practical X-Ray Work and Allied Arts and Sciences.

VOL. XV. CHICAGO, SEPTEMBER, 1904. No. 3

The Principles of Electro-Therapeutics.

BY DR. T. PROCTOR HALL.

A paper presented at the International Electrical Congress of St. Louis, 1904.

From the known physical, chemical and physiological effects of eletric currents it is possible to draw fairly accurate conclusions as to their therapeutic uses; and when these data are combined with the results of clinical investigations, the principles of electrotherapeutics are set forth ready for application for the relief of mankind.

ELECTRIC CURRENTS.

It is essential that the practician should have first a clear concept of the nature of an electric current. For this purpose the Vortex theory of electricity and magnetism offers the simplest working hypothesis. According to this theory an electric current is a vortex ring, consisting of a bundle of chains of polarized and rotating atoms, each chain forming a complete circuit. Any substance, such as copper, which permits of the rotation of its atoms in such polarized chains is called a conductor. A substance, such as quartz, whose atoms are so firmly fixed in their relation to each other that no such continuous rotation is possible, is called a non-conductor.

By an electromotive force, which, according to this theory, is a polarizing and rotating force, the atoms of any substance may be rotated to some extent. In a nonconductor the extent of the rotation is in direct proportion to the force applied, and is therefore determined by the magnitude of the electromotive force.

The rotation of the atoms at the surface of a nonconductor is necessarily conveyed in part to the adjacent atoms. This capacity for conveying an electric strain through its substance is known as dielectric capacity. The dielectric capacity of glass or mica is several times as great as that of air; in other words, the effect of an electromotive force is much more pronounced thru a millimeter of glass or mica than thru a millimeter of air. The dielectric capacity of a good conductor is almost infinite; in other words, the conductor conveys an electric strain from atom to atom with practically no loss.

If we assume that the right-handed rotation of a chain of atoms constitutes a positive current, then a left-handed rotation is a negative current. It will be observed, however, that a rotation which is right-handed to one person is left-handed to the one who stands facing him. The same current (rotation) is therefore at the same time both positive and negative, according to the point of view. The difference between a positive and a negative current is relative only.

The direction of a current of low potential may be found in several ways. If the current passes near a magnetic needle which is free to turn, the north-seeking

end of the needle tends to point in the direction of the atomic rotation near it. If two common sewing needles be inserted into a piece of beef, half an inch or more apart, the anode needle sticks fast and the kathode needle dissolves the surrounding tissues and becomes very loose. The direction of an intermittent current of high potential, such as is obtained from a static machine, may be determined from the appearance of the spark. When the spark gap is small, the spark has a short white streak at the kathode, a long white streak at the anode, and a fainter violet line across the middle. When the electrodes are far apart the spark appears to branch from the anode or positive pole, which forms the trunk, and the branches, after disappearing, seem to re-collect into a heavy white streak a short distance from the kathode. In either case the spark will follow a pointed stick which is moved across its path close to the anode, while it pays very little attention to the same stick moved across at the kathode.

A direct current is one whose rotation is in one direction only. If the direction of the rotation is periodically changed, the current is alternating. These, the direct and the alternating, are the two main classes of currents.

If some of the atoms in a polarized chain belong to a nonconductor they are unable to take part in a continuous rotation, consequently the chain can not rotate, and there is no current. But if the electromotive force is sufficiently great the nonconducting atoms may be torn from their associations and compelled to rotate. The nonconductor is in this way pierced or broken, and the sudden expenditure of energy usually gives rise to a perceptible amount of heat and light. This phenomenon is called a spark discharge.

If the electromotive force is not great enough to cause a spark, the atoms at the surface of the nonconductor remain strained further than those in the interior. This strained condition of atoms at the surface is called an electric charge. It will be noticed that the strain on one side of the nonconductor is right-handed, forming a positive charge, while the strain on the other side is left-handed, forming a negative charge, the observer being supposed in each case to face the surface under consideration. The absolute direction of the rotation is of course the same on the two sides.

If the original electromotive force be removed the strained atoms return to their normal position, and in so doing produce a current in the opposite direction. The positive charge, which was produced by a positive current passing toward the surface, produces a positive current from that surface, and similarly with the negative charge.

Along the sides of the rotating chains of atoms the elastic ether (which may be thought of as a soft solid) is displaced to a slight extent in the direction of the rotation. This displacement is magnetism. From the sides of an alternating current proceed magnetic waves which are plane-polarized. From the end of a conducting chain of atoms which are subjected to an alternating electromotive force proceed cylindrical waves which have all the essential characters of waves of ordinary light.

The rotating atoms in a conductor strike against each other and against other atoms, and impart to them an increase of vibratory velocity (heat). Some of the energy of the current is

thus wasted in a conductor. The proportion of energy so wasted depends upon the physical and chemical conditions of the conductor, and is a measure of the resistance of the conductor. If a pure metal were cooled to the absolute zero of temperature there would be no waste of energy in this way and the resistance of the metal would then be zero.

The commercial units used in connection with electricity are arbitrary. The unit of current (total amount of rotation per second) is the ampere. The current used in a sixteen-candle power incandescent lamp is about six-tenths of an ampere. One-tenth of an ampere is considered the limit of current which may be safely passed thru any vital portion of the body, for example, from one hand to the other, thru the chest. Therapeutic currents are measured in milliamperes, or thousandths of an ampere.

The unit of electromotive force is the volt, which is approximately the force of a single salammoniac cell or a dry cell after it has been used a little time. The usual voltage of an incandescent light circuit is one hundred and ten. The voltage of trolley circuits is about five hundred.

The unit of resistance is the ohm. The resistance of 260 feet (eighty meters) of No. 18 copper wire is one ohm. The resistance of fine wire is proportionately greater. One foot of No. 40 copper wire has a resistance of one ohm. The resistance of the human body varies from about five hundred ohms upward, according to the kind of contact made with its surface. Roughly speaking, the conductance of the various tissues is in proportion to the amount of water contained in each. The relation between these three elements, electromotive force (E), current (I), and resistance (R) is shown by Ohm's Law, which is:

$E=RI$, or numerically,

Volts=Ohms $\times$ Amperes.

This implies that the current may be increased by increasing the electromotive force or by decreasing the resistance.

ELECTROLYSIS.

When an electric current is passed thru a liquid containing a salt in solution the end of the conductor from the positive (carbon or copper) pole of the battery is considered to be the road by which the current enters the solution (according to the fluid theory of electricity). It stands, therefore, at the source of the electric stream in the solution and is called the anode (up-road). The other electrode at the bottom of the stream is called the kathode (down-road) and is in direct connection with the negative or zinc pole of the battery. The molecules of the salt are polarized by the electromotive force, and one after another are split into two parts by the current. This splitting is called electrolysis. The two parts into which each molecule is split are called ions (wanderers). The splitting takes place in the same way as in the double decomposition of chemical salts, namely into a basic part and an acid part. The basic parts move in the direction of the positive current (down stream) toward the kathode, and hence are called kations. The acid parts move in the opposite direction (up-stream) toward the anode, and hence are called anions.

In the case of common salt ($NaCl$) the sodium atoms are the kations and collect around the bathode; the chlorin atoms are the anions and collect around the anode.

In every case the direct effect of the current is to split the molecule into two and only two parts. But in many cases secondary changes take place, which are undoubtedly electrical in character but which are most conveniently considered

to be the chemical results of the unstable conditions formed by electrolysis. Metallic sodium decomposes water, setting free hydrogen gas and forming caustic soda: $2Na+2HOH=2NaOH+H_2$. At the anode the chlorin ions may decompose water, forming hydrochloric acid and oxygen gas; $2Cl_2 + 2H_2O = 4HCl + O_2$ similar changes take place with other compounds. The secondary reactions are all of the same character, and may easily be written down by one who has a knowledge of elementary chemistry. The metals and alkaloids are kations; the acids radicles are anions.

The physiologic effects of a direct current are mainly in the vicinity of the electrodes. Since common salt is one of the most abundant of the salts in solution in the body, its behavior under electrolysis may be taken as a type of the changes produced by electricity in the tissues. Near the anode we have increased oxidization, and the hardening or stringent effect of the acid. Near the kathode we have deoxidization and the softening or dissolving of tissue by the alkali. Considering in particular the effect upon the smaller blood vessels, near the anode these are constricted and ischemia produced; near the kathode they are dilated, causing hyperemia. Pain usually results from pressure upon nerve endings, and in such cases relief can be obtained by the astringent effect of the anode. Defective nutrition in any part is frequently due to defective blood supply, and in such cases can be improved by the hyperemic effect of the kathode. Either the acid or the alkaline effect may be made so intense as to cause destruction of tissues. For the removal of dermal defects (warts, moles, nevi, etc.) either electrode may be used. The anode forms a hardened mass of coagulum and connective tissue. The kathode softens and dissolves so that the abnormal growth is more readily removed by the lymphatics. The anode is therefore to be preferred where cutting off the blood supply is the essential part of the treatment, and the kathode where the removal of all traces of hypertrophied tissue is more important. The kathode is successfully used for the relief of urethal, rectal, esophageal and other strictures. A current so mild as not to produce any marked degree of inflammation is used repeatedly, and this gradually dissolves the constricted scar tissue.

Kathode	Electrodes	Anode
	Molecule	
	Ions	
Kations		*Anions*
Basic, metallic or Alkaline,		Non-metallic, or Acid
Relaxing,		Astringent,
Softens and dissolves,		Coagulates and hardens,
Causes hyperemia,		Causes ischemia,
Increases pain,		Reduces pain,
Excites,		Sedative,
Deoxidizes,		Oxidizes.

FORESIS.

The term foresis is applied to the motions of the ions when made use of to carry medicaments into some particular part of the body. The motion of metallic and basic ions toward the kathode is termed kataforesis, and the motion of the acid ions toward the anode, anaforesis. The amount of foresis is dependent upon the intensity of the current, and has no direct relation to the electromotive force, so long as the latter exceeds a few volts. Kataforesis has been successfully used for the destruction of malignant tumors and the sterilization of adjacent tissues by heavy currents from amalgamated zinc needles.

When the current is alternating, or

when the polarity is frequently changed, foresis takes place in alternate directions. The result, instead of being zero, is a scattering of both sets of ions throughout the tissues. Molecular diffusion then takes place much more rapidly than it would without the action of the current.

The remarks made up to this point regarding the polar effects of the electric current apply to direct currents only. When an alternating current is used there are no polar effects, provided the positive and negative portions of the current are symmetrical. The molecules are split into ions just as in the case of the direct current, but the ions have the opportunity of reuniting when the current is reversed. If the original molecules are stable under existing conditions this reunion takes place, leaving the chemical composition precisely as it was before. But such conditions are rarely, if ever, found in the tissues. The chemical changes by which the food is finally oxidized are constantly taking place. Electrolytic action facilitates these changes by assisting in the decomposition of molecules. Physiologically this means acceleration of metabolism. Therapeutically this stimulus is advantageous wherever metabolism is deficient, or where tissue debris has accumulated, or where local bactericidal infection occurs, or where abnormal growths are taking place. In all of these cases the completion of normal tissue changes removes the pabulum of pathological cells.

It is important in this connection to note that of the three essential life processes,—nutrition, metabolism and elimination,—the alternating current accelerates chiefly metabolism, and it is necessary to look closely after nutrition and elimination by other means.

SENSORY REFLEXES.

Some of the most marked effects of electricity upon the human body are produced through sensation. These effects are not peculiar to electricity, but they have been to a very considerable degree overlooked by other therapeutists. The involuntary muscular system maintains its tone in part by the reflex action of the unnoticed sensory impulses which are continually received through touch, hearing, sight, etc. If these mild and general sensations are increased in intesity, the reflexes become stronger. The blood vessels, for example, are constricted, raising the blood pressure, the heart beats more strongly, respiration is deeper and there is greater tension in every part of the organism.

Locally these reactions may be used to great advantage. In case of local hyperemia, in which there is abnormal distension of the smaller blood vessels, a slight increase in the sensory reflexes in that region is frequently sufficient to cause a return to their normal size, which stop exudation and cause reabsorption of the exudate. If coagulation has not yet taken place this reabsorption is very rapid. The necessary stimulus may be given by brushing the skin with a soft feather or a camel's hair brush, or by passing the finger tips over it very lightly, or by tapping gently with a light stick, or by the lips of the mother who may "kiss the spot to make it well," or by the spray or breeze from a static electric machine. Similar effects may be produced near the surface by an astringent wash, and at a considerable depth under the anode by the direct current. Using a mild breeze from the positive electrode of a static machine the sensory and polar effects are combined. Bruises, varicosities, rheumatic swellings and similar painful hyperemic

conditions are often promptly relieved by this treatment.

When sensations are greatly increased in intensity the normal reflex fails through overstimulation of the nerve centers. The effects are then irritating, the exact opposite to what they were before, resulting in a hyperemic condition of the part. This condition may be obtained electrically by any painful application of the current. It is advisable where hyperemia is desired to combine the chemical effect of the kathode with the sensory effect of the pain. Violent stimulation results in a condition resembling shock, in which the reflex almost disappears.

In some persons and in some abnormal conditions the senses are excessively acute; in others very dull. The sensory effects are dependent upon the amount of sensation and the condition of the nerve centers, and not merely upon the amount of force applied.

MUSCULAR STIMULUS.

Upon the neuro-muscular system electricity acts directly to produce muscular contraction. These contractions are mainly caused by changes in the intensity of the current, and the more sudden the change the greater is the amount of contraction. For muscular effects it is important that the current changes be not too rapid to permit of complete relaxation, otherwise the circulation is impeded by the contractions and no benefit results. In treating the nerves the current changes may be made much more rapidly. When the changes are very rapid, say 5,000 per second, the conductance of the nerve for ordinary stimuli is temporarily lost.

IDEATION.

By ideation or suggestion is meant the production or reproduction of ideas or concepts in the mind of the patient. While this can not be done directly by means of electricity, the conditions of electric treatment are in most cases unusually favorable for it and it becomes, therefore, an important part of the treatment. Ideas suggested to the patient are consciously or subconsciously accepted by his organism if the organism is in a receptive condition. The essence of receptivity is the absence of resolution on the part of the patient. He may be in a condition of complete rest, or of nervous excitement, or of surprise; in all these there is irresolution, and suggestion is then effective.

In taking an electrical treatment the patient is introduced to apparatus that is strange and mysterious. He is outside of his usual conditions. His ordinary mental routine is interrupted, and his subconscious mental acts are subjected to new directions and impulses. In this bewildering maze he looks to one source, the physician, for safety and direction. A statement from his physician regarding the changes which are being induced in his organism causes an expectant attitude of the subconscious personality of the patient which materially assists in bringing about the desired changes. It is not necessary, in fact it is injurious, to go beyond absolute truth in giving these suggestions. They must be made clearly, confidently and repeatedly, in order to produce the best results. Probably one-half of the total effect of electric treatment in general practice is due to the sensory reflexes and suggestion.

RADIATION.

The x-rays are believed to be electric waves corresponding, to some extent, to waves of light. Clinical observation is in harmony with the view that the effects of waves of light and electricity are very like those of alternating electric currents, especially high-frequency currents. There is first the stimulating influence upon

metabolism. This may be mild, or strong, or destructive. In the second place there are the sensory reflexes already described. The treatment of abnormal growths by any form of electric wave is based upon the fact that as living organisms abnormal cells are less stable than normal cells. Consequently an irritation which is not sufficient to cause serious injury to normal cells may be strong enough to be destructive to abnormal cells. The essence of such treatment, therefore, consists in applying the stimulation so intensely as to cause gradual destruction of abnormal tissues, stopping short of serious injury to normal tissue.

If the abnormal tissues are of considerable size, as in pulmonary tuberculosis, large, malignant tumors and degenerative conditions of the blood or muscular system, there is danger of systemic poisoning by toxins formed from the diseased tissues by the radiations. The treatments must then be at first short and mild and increased slowly, while all the channels of elimination are kept free.

The form of radiation to be selected depends chiefly upon its power to reach the part desired. Sunlight and artificial lights penetrate the tissues to a slight degree and are, therefore, advantageous for surface treatment only. X-rays of low penetrative power, which are obtained from a low vacuum tube, can also be applied only at or near the surface of the body. Rays of high penetration which are obtained from a tube of high vacuum pass without difficulty thru the soft tissues and may be utilized for the treatment of deeper lesions.

Radiations that pass entirely thru the tissues are wasted. Only those that are stopped by the tissues do work there. Consequently the vacuum of an x-ray tube must be so adjusted that its rays reach the part to be treated, but do not pass thru to any considerable extent. Then all the available energy is expended in the desired region. The more highly differentiated tissues, such as hair and sweat glands, are more quickly injured by x-rays than the less differentiated tisues.

The part played by electrons in electric treatment is not yet very clear. The general effects of radium emanations are similar to those of electric waves of low penetration.

SUMMARY OF EFFECTS.

The known effects of electric currents may be summed up as follows:

1. Heat.
2. Magnetism.
3. Radiation.
4. Induced currents.
5. Electrolysis and foresis.
6. Neuro-muscular stimulation.
7. Sensory reflexes.
8. Ideation.

Heat is always produced in a conductor by an electric current, but the amount of heat is so small in comparison with the other effects that it may be neglected in therapeutics.

Around every current are magnetic strains of the ether. The effects of these upon the body are practically zero, except when the currents are alternating and the magentism, therefore, constantly changing its polarity. Intermingling with these magnetic changes, and to a considerable extent identical with them, are induced alternating electric currents. Magnetism as a distinct factor in the treatment may consequently be disregarded, and the effects considered as due to the induced currents only.

Ether waves and streams of electrons exist almost everywhere. They undoubtedly play a large part in the ques-

tion of health and disease. The negative electrons, which are much smaller and more rapidly moving than the positive electrons, are of great therapeutic importance, but beyond this we can, at the present time, say very little of them.

Electrolysis takes place wherever an electric current exists in a solution. Foresis always accompanies electrolysis. With direct currents the polar effects are very pronounced; the interpolar effects relatively insignificant. With alternating currents the electrolysis loses its polar character and becomes metabolic stimulation, and foresis becomes an assistance to molecular diffusion. These two processes accompany all forms of electric waves and are characteristic of sinusoidal currents, high-frequency currents, x-rays, light and radiant heat.

There is nothing magical or mysterious about the therapeutic effects of electricity. In the physical world there is no form of energy that is more capable of adaptation to all conditions. In therapeutics, also, a great variety of effects may be obtained at the command of the operator. Electricity, therefore, is not in any sense a specific for any disease, nor, on the other hand, may it be considered a cure-all. It is merely an exceedingly valuable physical agent, which, when applied intelligently and with the proper understanding of the human organism, can be depended upon for certain and definite results. The force applied can be exactly measured; the result can be foretold with certainty, so far as the electric side is concerned. Some uncertainty remains and always will remain on the side of the patient. The skill of the physician is constantly required to determine exactly the pathologic condition and recuperative power of the patient, and to judge of the form and extent of the curative agent best suited to his condition. The time has gone by when the physician is justified in using electricity alone in any of its forms for the purpose of determining its effect. The general nature of these effects has already been determined. The physician's duty now is to acquaint himself with them and to use them together with all other available measures to benefit his patient.

American Electro-Medical Society.

The second annual meeting of this society will be held at the Masonic Temple, Chicago, December 1 and 2, 1904. The committee of arrangements consists of Dr. Stuart Johnstone, Dr. J. A. Robinson, Dr. John E. Gilman, Dr. O. W. McMichael and Dr. Joseph R. Hawley.

The officers for 1904 are as follows: President, O. Shepard Barnum, M. D., Los Angeles, Cal.; vice-presidents, T. Proctor Hall, M. D., Ph. D., Heber Robarts, M. D., Mihran K. Kassabian, M. D., H. C. Bennett, M. D., M. E., S. D. Greenwood, M. D., J. Mount Bleyer, M. D.; secretary, T. Proctor Hall, M. D., Masonic Temple, Chicago; treasurer, O. W. McMichael, M. D.; chairman of the executive council, H. Preston Pratt, M. D.

Papers and communications may be addressed to the secretary.

The Action of the Constant Current on the Vitality of Microbes.

BY DR. S. SHATZKY.

A paper presented at the International Electrical Congress of St. Louis, 1904.

In my work, "Biological Data Relative to the Treatment of Acute Inflammations,"[1] it became possible to explain, by facts already determined in science, my observations on the favorable action of the current in local inflammations, that the current through increase of the local nourishment strengthens the resistance of the cellular elements against the harmful agent, of whatever nature the same may be. I also was able to explain the healing action in tuberculose treatments,[2] partly through the increase in resistance of the cellular elements against the action of the tuberculosis bacilli, and through the elimination of the inflammation phenomena following these processes, caused by the participation of other microbes.

In order to more fully grasp the action of the constant current in inflammations of a microbe origin, I found it necessary also to learn its direct influence on the microbes themselves. I have devoted the present paper to this question.

Although this matter is of great importance, it has hitherto been discussed very little. The literature on the subject is very limited. Of the few authors who have published their observations in this direction, not one has so combined his experiments that they accord with the galvanization employed for therapeutical purposes. Krüger,[3] for example, galvanized microbe cultures, in the course of 24 to 30 hours, with a current of a strength up to 20,000 milliamperes. Apostoli and Laqueriere[4] employed a current of 50 to 300 milliamperes for only five minutes, and directed their observations mainly on the effect of the positive pole. Cohn and Mendelsohn[5] employed currents of very small pressure of from 2 to 12 volts, etc.

However important the results of such experiments may be in a theoretical way, they present only a moderate interest from the practical standpoint. In order to define the advantages or disadvantages of the action of the constant current on microbes in its therapeutical application, it seemed rational to me to make the experiments in a manner approaching as closely as possible to the mode of application in therapeutics. I, therefore, endeavor to remain within the limits employed in therapeutics, both as regards power and duration of galvanization. I did not fix my observation on the polar action of the current, but on the phenomena which it exercises on the vitality of the microbes in the interpolar space. The following observations caused me to do this:

1. The actions of alkalis and acids on the vitality of microbes are sufficiently well known in bacteriology. We can, therefore, conclude, independently of experimental research, as to the specific influence of the poles, which corresponds to their chemical nature.

2. As the seat of inflammation always attacks, more or less, a part of the thick-

1. *Comptes Rendus* of the Second International Congress of Medical Electrology at Bern, 1902.

2. S. Schatzky: "The Constant Current as a Cure for Tuberculose." *Comptes Rendus* of the Second International Congress of Medical Electrology at Bern, 1902.

3. Kruger: "Ueber den Einflun des Konstanten Stromes auf Wachsthum und Virulenz der Bacterien" (*Zeit f. Klin. Medicin.*, XXII, 1893).

4. Apostoli and Laqueriere: "De l'action polaire du courant galvanique constant sur les microbes et en particulier sur la bacteridie charbonneuse." *Comptes Rendus* Ac. Sc., Vol. 110, 1890.

5. Cohn & Mendelsohn: "Ueber die Einwirkung des elektrischen Stromes auf die Vermehrung der Bacterien." *Beitrag* zur Biologie del Pflanzen, III, 1888.

ness of the tissues, it is a question, in the therapeutical employment of the current of its interpolar action. Even in cases where we place the electrodes directly on the injured surface, we do not cause a specifically polar effect of the current—in the sense as understood in physics. Between the metal serving as pole and the injured surface there must always be an intermediate layer of liquid—moistened chamois, wadding, linen or similar material—without which galvanization, with the exception of a few special cases, is impossible.

3. In cases, however, where the seat of sickness is concentrated in internal organs, such as the lungs, liver, etc., there can be no question of the therapeutical application of the polar action of the current.

In view of these observations, I made my experiments in the following manner: In order to have a homogeneous center, with uniformly distributed microbes, I sowed all cultures (with the exception of *M. Prodigiosus*) into beef bouillon. I kept the liquid containing the culture in a glass tube of a diameter of 1 cm. and a length of 20 cm. The two ends of the tube extended into vertical arms, *a*, *a'*, each 8 cm long. From the middle of the tube there arose a similar tube *b*. I placed in *a*, *a'* the electrodes of thick platinum needles, which were connected with a battery of 40 elements. A milliammeter was included in the circuit. Every time, before the galvanization, a culture was transferred from the liquid to the central tube, and in the case of experimentation with animals, there was also made an inoculation. Those primary cultures and inoculated animals served as proofs. Then the circuit was closed, and at determined intervals—without breaking the current—experimental cultures and inoculations were made from the same central tube. After but a few experiments with *M. Prodigiosus* I became convinced that currents of 20 to 30 milliamperes during a period of 10, 15, 30, even 45 minutes, produce no sensible change in the vitality of the microbes open to our observation. Therefore I either had to increase the currents or lengthen their duration. But stronger currents heat the liquid and introduce a foreign agent—heat—which disturbs the clearness of the experiment. I, therefore, preferred to increase the duration of galvanization.

RESULTS OF THE EXPERIMENTS—MICROCOCCUS PRODIGIOSUS.

The cultures of this microbe only were made in gelatine. I judged as to the changes which the current produced in the vitality of this microbe, by the quantity of thinned-out gelatine and the quantity of colored substance (pigment) produced by the microbe. Repeated experiments proved that cultures, which were made from microbes, subjected one and one-half hours to the current, showed themselves less developed after 24 hours, in comparison with the proofs, with respect both to the quantity of thinned galatine and the degree of coloring. This difference was employed in the cultures, which developed from microbes galvanized for one and three-fourths hours. After a two-hourly galvanization the growth of the microbes could be barely noticed. I did not observe the complete cessation of growth a single time within the limits of these experiments.

CHICKEN CHOLERA.

The experiments with these microbes had the purpose of learning the influence which galvanization exercises on its virulence and growing capacity. For this pur-

pose I inoculated intramuscularly at every experiment three rabbits with 1-10 cc.—the first with a normal culture (proof), and the second and third (experiment subjects) with cultures which had been subjected to galvanization for different periods. Simultaneously cultures were also made on bouillon. The experiment proved that a noticeable decrease in virulence occurs only, from the culture injected, after galvanization for one and one-half hours. The death of rabbits inoculated in this manner occurred 5, 10, and even 20 hours later than that of the proof. A galvanization of one and three-fourths hours or longer completely destroyed the virulence of the microbes. As regards the cultures, their growth did not cease even after a galvanization of 2 hours and 10 minutes. It interested me to test the degree of immunity of the rabbits which had remained alive after such an inoculation with this microbe. For this purpose I inoculated a rabbit which had been vaccinated 10 days before, and at the same time treated a proof with 1-10 cc. of a culture which had been subjected to galvanization for only 30 minutes. Both died, however, after 14 or 15 hours. A similar negative result was produced by an experiment with a rabbit which had been inoculated 13 days before, into which I injected—at the same time with a proof—1-10 cc. of a culture which had been subjected to a galvanization of 45 minutes.[6]

As to the question whether galvanized microbes give cultures of a lesser virulence, I obtained positive results by experiments carried out as follows: I prepared a culture of microbes which was galvanized for 1 hour and 40 minutes, and which killed a rabbit only after 39 hours. The culture thus produced was again subjected to galvanization, and I inoculated one rabbit with 1-10 cc. after 1 hour and 30 minutes, the second after 1 hour and 40 minutes and the third after 2 hours and 10 minutes. Cultures were also made simultaneously. The result was that all the rabbits remained alive and none of the cultures developed. It is clear that the generations, which generated from microbes galvanized within these limits, are considerably weaker in their virulence and proved incapable of further generation.

STREPTOCOCCUS.

The streptococcus, which I employed for my experiments, possessed very great virulence. Dr. Beszedko, who put this microbe at my disposal in the most amiable manner, increased its virulence in such a degree, that one-twentieth million in doses of 1-10 cc. acted fatally on white mice.

The experiments with this, as with the previous microbes, were for the purpose of studying the action exercised by the current, with respect to virulence and propagation. The inoculations were made subcutaneously on white mice at the root of the tail with 1-10 cc.

In the first experiment, which may serve as prototype for all the others, there were inoculated:

I. Proof with normal culture; died after 16 hours.

II. After galvanization of 45 minutes; died after 40 hours.

III. After galvanization of 1 hour and 10 minutes; died after 40 hours.

IV. After galvanization of 1 hour and 45 minutes; remained alive.

V. After galvanization of 2 hours and 10 minutes; remained alive.

The current strength was 25 to 30 milliamperes. All cultures made at the

6. As the question of immunity did not come within the scope of this work, and requires a special minute examination, I dropped it entirely in the subsequent experiments.

same time with the inoculations showed a prolific growth.

All other experiments made in this manner gave comparatively similar results. On the whole, it can be said that a noticeable decrease in virulence of this microbe can be detected only after a galvanization of 45 to 60 minutes. The decrease is in accordance with the length of galvanization. After about one and three-fourths hours the virulence disappears entirely with the dose and current strength indicated.

I did not observe a noticeable influence of the current on the growth of the cultures in these experiments. Does the virulence also decrease in the generations of steptococci produced from galvanized microbes?

The experiments made for this purpose gave positive results.

The cultures which developed from microbes, galvanized for two hours and ten minutes, did not kill the animals after sixteen to eighteen hours, but after forty-five to forty-eight hours.[7]

As to the fact that I do not give definite, but approximate, figures in my observations, I can set forth the following reason in justification: In the combination of experiments, such as mine, so many different influences enter that it is quite impossible to repeat the same experiment with absolute accuracy. Only that which relates to the current can be repeated with exactness. As regards, however, the nourishment of the cultures, the animals employed in the experiments, and mainly the microbes themselves, these are factors which are only too changeable. It is an easy matter to carry out accurately one or two points, but to exactly group all elements in order to accurately repeat an experiment, is a matter of impossibility. Nevertheless, definite conclusions can be drawn from a series of observations.

7. In order to extend the scope of my experiments, I undertook similar experiments with the *Staphylococcus*. Its virulence proved, however, so low that the wounds caused by it were too slight to merit mention here.

CONCLUSIONS.

My observations cause me to conclude:

(1) That the constant current exercises in the interpolar space a modifying influence on the vitality of the microbes.

(2) That currents of twenty-five to thirty milliamperes exercise in one and one-half to two hours an action varying from a weakening to an entirely deadly effect in their virulence.

(3) That generations, which develop from microbes galvanized in this manner, develop a lesser vitality than their generators.

How does the constant current act on the microbes in its interpolar space?

There are authors who believe that the study of the action of electricity on the animal body must consist in the explanation of the influence of a mysterious unit of a so-called pure electric agent, independently of other physical properties of this energy, such as heat, electrolysis, etc. Dr. Krüeger, for example, gives in his work, "On the Influence of the Constant Current on the Growth and Virulence of Bacteria,"[8] a whole series of special experiments, in order to fathom the influence of the "actual action of electricity." He says: "As with the entrance and exit of the current in liquids, the polarization and chemical decomposition of the same almost entirely cover the real action of electricity, it is absolutely necessary to exclude this disturbing secondary action * * *." He does not explain what he means by "real action of electricity." The results of his experiments are recapitulated by him in the following

8. *Zeit f. Klin. Medicin.*, XXII, 1893.

manner: "It follows from these experiments that the constant electric current can, by excluding as much as possible the chemical action of the ions, if not kill, undoubtedly arrest, the bacteria completely in their growth." But he gives no explanation, excepting as to the ionic action, in what the influence of the current exists.

Apostoli and Laqueriere set forth their observations in their work, "De l'action polaire du courant galvanique constant sur les microbes,"[9] in the following manner:

(4) The general conclusion which follows from our researches is that the continuous current in medical doses (50 to 300) has no action sui generis in the microbe cultures * * *." The authors explain the results observed by them by the chemical action of the positive pole. This is quite rational, but it is incomprehensible as to what other action "sui generis" they expected of electricity. I make free to add that in personal conversation with many important scientists I have heard similar views expressed.

Such a view of the action of electricity on the animal body is, in my opinion, a complete error. Electricity, as a physical agent, influences matter irrespective of its nature, through the combined action of all its properties, and only in this way can the phenomena produced in the body be explained.

It is true that each time, in the different forms of this energy, its different properties appear as predominating. But there is no form of electricity in which any one of its properties is absent. Such an energy would not be an electrical one, but one which is still unknown to us. In the action of the constant current in properties and values, as employed by us in our experiments, its electrolytic properties are predominant. We must, therefore, look in them for the explanation of the results observed. There is no doubt that the constant current produces at the same time with chemical, also molecular changes in the animal body. But they continually go hand in hand, and can in no manner be studied separately. It is a matter of absolute impossibility to isolate the molecular from the chemical phenomena. This would also be entirely useless, as in the present conditoin of science these two phenomena are considered as identical in their nature.

In my work, "The Basis of the Therapeutical Action of the Constant Current,"[10] I came to the conviction by way of experiments that:

a. The electrolytic phenomena, which the passage of a constant current through the electrolyte causes, take place in the interpolar space as well as at the poles.

b. In the entire distance traversed the ions travel, as though charged with pressure electricity, to the poles as to the extreme points of highest attraction. This process will doubtlessly also take place, under the action of the current, in the liquid in which the microbes are suspended. The dividing of the electrolyte into ions and their migration will not only take place in the liquid alone, but also in the microbes in their protoplasm, which certainly contains electrolytes, as salts and water. This alone suffices to act in a modifying way on the vitality of the microbes. It has been determined in bacteriology that even a simple plasmolysis may prove deadly for microbes at a certain strength. The more reason to assume, that an electrolytical decomposition of the plasm must cause large changes in the physiological functions of the microbe. It is also known that the microbes,

9. *Comptes Rendus* Ac. Sc., Vol. 110, 1890.

10. *Zeit. f. Elektrotherapie*, March number, 1900.

although they have a great death-resisting capacity, are quite easily affected by exterior influences, and easily react on the same. It is understood that in the center in which the microbes are suspended, the changes caused by the current—an increase in acid and alkalis—must also influence the vitality of the microbes. In this case the action of the current can be compared to that of sunlight, which, as has been determined, exercises through its chemical action on the center, a strong influence in retarding the growth of the microbes. As specially reductive of the bacteria were found to be the ions of oxygen and chlorine, appearing in a nascent state in the center and which, as known, are among the strongest bactericidal agents. In fact, there are sufficient reasons from consideration of the physical-chemical properties of the current to explain the changes in the vitality of the microbes which I observed in my experiments.

I will here take advantage of the opportunity to thank most warmly Dr. Borel, whose amiable and highly scientific advice greatly facilitated the execution of my work.

Involuntarily the question comes up, Does all this take place as accurately as in a glass? Certainly not with absolute accuracy, although according to the laws of physics, the constant current produces in the animal body, qualitatively as well as quantitatively, the same phenomena as in the experimental tube. The difference is probably caused by the conditions of the center. In the tube the current acts on a constant homogenous center, and on a perfectly limited mass. In the animal body, however, all these conditions do not exist. Here the current spreads much more fan-like. The products of electrolysis are partly produced and assimilated by the surrounding tissues, and partly carried off by lymph and blood current. Therefore an acid resultant will not, all other things being equal, reach the same degree of intensity as in the tube. From this it follows that the current in the animal body will not exercise full influence on the microbe inhabitants, as is done in the experimental culture. But we must not draw the conclusion therefrom that the action of the current in the animal body is necessarily weaker. It may even be more intense. This will depend on the conditions under which the life of the microbe occurs in the animal body. In the experimental culture, the microbes are left to themselves, and under conditions most favorable to their nourishment and rapid propagation. In the animal body, however, they must battle for their existence with the elements of the surrounding tissues. They are placed under the necessity to overcome here for their nourishment and propagation, the complicated resistance of the tissue cells, which represents a considerable antagonism to their activity. It is clear from this that it is much more difficult for the microbes in the animal body to resist the action of the current, than in the experimental culture.

Nor may it be forgotten that the passage of the current[11] increases the local nourishment of the tissues, and with it the resistance of the cells. This circumstance will also in its turn make the conditions of living worse for the microbes. Finally, nothing forces us to limit the therapeutical galvanization to twenty-five to thirty milliamperes. We can, according to circumstances, increase the current two or threefold. Here the local increase in temperature, which I took such great

11. See my article: "Donnees biologiques relatives au traitement des inflammations aiguees par le coursant continu." *Comptes Rendus* du Second Congres international d'Electrologie medicale, a Bern, 1902.

care to prevent in my experiments, is not to be feared. Such a phenomenon would even be very useful in this case for therapeutical purposes. In his excellent and exhaustive work, "Elements de microbiologie générale,"[12] Dr. Nicolle says: "It has long been known that the leucocytes require a certain degree of temperature, in order to develop their ameboid activity * * *. It is likewise known that the white cells greatly require oxygen and that they invariably turn to the points richest in air. Heat and oxygen thus represent here two powerful exciters." Under these conditions the current appears, so to speak, as exciter of phagocytosis, which under certain circumstances can render essential services to therapeutics.

From all that has been said above, it can be concluded that the action of the current on the microbes living in the animal body is identical to the one which I observed in my experiments. In this manner the importance of the current as a therapeutical agent in inflammations becomes considerably greater. The current not only increases the resistance capacity of the tissue cells against the harmful agent, but also acts in inflammations of a microbe origin directly on the microbes themselves, by reducing their vitality.

In the interest of scientific truth I found it rational in my examinations to limit every experiment to a single period of galvanization. With a patient we can, however, repeat the application daily, and in extreme cases, two to three times daily. And after such repeated action of the current, the therapeutical effect must become considerable. My experiments proved that the generations produced by galvanized microbes have a less virulence than their generators. We must assume that the microbe culture vegetating in the animal body will gradually generate weaker generations, following repeated galvanization. Their part as harmful agent must in this manner gradually lessen and finally disappear. At the same time the resistance of the cells attacked will increase up to their complete recovery.

All the above facts and observations offer new grounds to explain the favorable action of the constant current in inflammations. The clinical observations published by me and other authors may serve as direct confirmation of this. I intend, however, in order to fully clear up the question, to make further direct laboratory experiments and exhaustive clinical observations.

12. M. Nicolle: "Elements de microbiologie generale," p. 198.

A Roentgen Ray Congress.

A congress to discuss the Röntgen methods will meet in Berlin on April 30, 1905. Professor Röntgen will be the guest of honor of the congress, which marks the tenth anniversary of the publication of his discovery.

We regret to announce the death of Dr. I. P. Klingensmith, of Blairsville, Pa., who died at his home on September 27, 1904, after an illness of five months, aged 54 years and 5 months. He was a member of the American Electro Medical Society.

Fifth International Electrical Congress, St. Louis, 1904.

PERMANENT ORGANIZATION.

At the general meeting of the congress in the Coliseum Music Hall at 9:30 a. m. on Monday, 12th of September, the following permanent organization was adopted unanimously:

GENERAL OFFICERS.

President—Prof. Elihu Thomson.

Vice-Presidents—Mr. Bion J. Arnold (chairman of executive committee), Prof. H. S. Carhart, Prof. W. E. Goldsborough, Mr. C. F. Scott, Dr. S. W. Stratton.

General Secretary—Dr. A. E. Kennelly, Harvard University, Cambridge, Mass.

Treasurer—Mr. W. D. Weaver.

OFFICERS OF SECTIONS.

	Honorary Chairman.	Chairman.	Vice-President.	Secretary.
A—General Theory.				
	Dr. S. Arrhenius.	Prof. E. L. Nichols.	Prof. W. L. Miller.	Prof. H. T. Barnes.
B—General Applications.				
	Prof. G. Grassi.		Mr. W. Deddell.	Prof. S. Sheldon.
	Prof. C. Zipernowsky.	Prof. C. P. Steinmetz.	Prof. F. Weber.	
C—Electro-Chemistry.				
	Prof. Dr. W. Ostwald.	Prof. H. S. Carhart.	M. Dennery.	Mr. Carl Heung.
D—Electric Power Transmission.				
	M. Paul Janst.			
	Ing. A. Maffezini.	Mr. Chas. F. Scott.	Ing. E. Jona.	Dr. Louis Bell.
E—Electric Light and Distribution.				
	Miguel Otamendi.	John W. Lieb Jr.	Dr. George Newbery.	
			Senor R. P. Arizpe.	Mr. Gano S. Dunn.
F—Electric Transportation.				
	Herr Baron Ferstel.			
	G. J. von Swaay.	Dr. Louis Duncan.	M. Marins Latom.	Mr. A. H. Armstrong.
G—Electric Communication.				
	John Hesketh, Esq.		M. Ferrie.	
	H. E. Harrison, Esq.	Mr. F. W. Jones.	J. C. Shields.	Mr. B. Gherardi.
H—Electro-Therapeutics.				
	Prof. J. A. Bergonie.	Dr. Wm. J. Morton.	M. G. de Nerville.	Mr. Wm. J. Jenks.

Notes of the Meetings.

The committee of organization of the International Electrical Congress, 1904, was appointed by the president of the St. Louis Exposition, June, 1903, and held its first meeting July, 1903. In response to invitations to join the congress over 2,000 acceptances have been received, 1,600 from the United States and 400 from other countries. On September 11th the rolls of the congress contained 1,700 names as having completed membership by payment of fee. In response to invitations to well-known workers thruout the world, 170 papers were presented to the congress, of which nearly 100 were in type for distribution at its sessions. The papers presented were generally of a high order of merit. They will be printed in a bound volume and distributed to members of the congress. The price of the volume to non-members is $10.

SECTION H—ELECTRO-THERAPEUTICS.

Under the able direction of the chairman, Dr. William J. Morton, twenty-one papers were presented, some of which summed up existing knowledge on certain subjects, while others gave reports of original and valuable investigations. Prominent among the latter were Dr. Morton's paper on "Artificial Fluorescence" and Professor Schatzky's paper on "Effect of the Constant Current on Microbes."

In the absence of their authors a number of the papers were read by title only. The discussions were animated and brot out much valuable information. Altogether section H was one of the most successful of the sections of the congress.

FLUORESCENCE ARTIFICIALLY PRODUCED IN THE HUMAN ORGANISM BY THE X-RAY, RADIUM, OR THE HIGH-FREQUENCY CURRENT.

Dr. William J. Morton read this paper and illustrated it by a considerable number of photographs. By the use of fluorescent solutions, taken internally, new radiations are set up in the tissues by the x-ray, light, etc. The human body normally contains a fluorescent alkaloid, "chinoidin." In malaria he had found the chinoidin reduced in quantity or completely absent. Quinin in sufficient doses restores artificially the fluorescent character of the blood and in this way destroys the malarial germs. In some experiments he found that paramecium in a fluorescent solution was able to live thirteen hours in the dark and only eight minutes in the light. It is found that the yellow and green light affect micro-organisms more strongly than the violet rays in fluorescent solutions. The substances experimented with are quinin, esculin and fluorescin, which he selected because of their harmless character. Twenty drops of a 3 or 4 per cent solution of one of these substances was administered, and an x-ray photograph of the hand was taken an hour later. The photograph was much more distinct in detail than one previously taken. The fluorescent effect is also made evident by holding a tube of radium against the ear in a dark room, when a distinct glow is visible.

Dr. Morton reported marked improvement in various patients by raying after the use of the fluorescent solutions. He was accustomed to give five drops after meals three times daily and to gradually increase the dose to twenty drops if tolerated.

REPORT OF THE COMMITTEE ON NOMENCLATURE AND STATIC MACHINES.

This report was read by Prof. Samuel Sheldon at the joint meeting of Section H with the American Electro-Therapeutic Association. A series of experiments was undertaken by the committee to determine the efficiency of the machines. Only three machines had been furnished to the committee in time for this test. The results showed that the efficiency was very small when the machines were running slowly. When the current furnished was near the maximum the efficiencies were 41 per cent for the Waite & Bartlett, 46.2 per cent for the Van Houten & Ten Broek, 42.8 per cent for the McIntosh. Taking into consideration the various sources of loss thru friction of air, friction of the bearings and leakage of the current, this efficiency of over 40 per cent in each case was considered highly satisfactory. The current is proportional to the speed of the machine, to the length of the collectors, to the distance of the combs from the center and to the number of collecting points. Full details were given of further experiments to determine the output of the various machines tested. The 8-plate McIntosh, speed 400, gave 0.649 milliampere. A 10-plate Waite & Bartlett, speed 380, gave 0.725 ma. A 2-plate Wagner (mica plate), speed 1,305, gave 0.34 ma. A 12-plate Van Houten & Ten Broek, speed 340, gave 0.968 ma. An 11-plate Titus, speed 265, gave 1.042 ma. Professor Sheldon regretted that more machines had not been placed at the disposal of the committee. The output in milliamperes is the equivalent steady discharge. The actual discharge from a static machine may be as high as 1,000 amperes, but each discharge continues for only a small fraction of a second.

Professor Jenks, the secretary of the section and a member of this committee, made brief reference to the two earlier reports of this committee to the electro-therapeutic association. He said the speed of a Wagner disk, at the center of the comb, was 4,400 feet per minute, or fifty miles an hour, while the speed of the McIntosh disk was only 1,200 feet per minute. Professor Jenks thot there was a good deal of misapprehension regarding high-frequency currents, many practitioners thinking they were using high-frequency currents when they had only the ordinary impulsive or spark discharge. The current is oscilatory when the square of the resistance multiplied by the capacity of the circuit is less than four times the inductance. Thumb rules may be adopted in order to secure high-frequency discharges; first, make the relative capacity of the body of the patient small, so that it becomes a conductor only and not a condenser; second, make the resistance of the whole circuit as low as possible; and, third, increase the inductance by the use of a short and coreless helix of heavy wire.

The resistance of a 2-inch air gap, which is probably 100,000 ohms or more, may become not more than 100 ohms after the spark has once begun. With the ordinary size Lyden jars, assuming the resistance of the patient to be 400 ohms, the frequency of the oscillation is nearly 6,000,000 per second.

Electro-Therapy.

LESSON XV.—X-RAYS.—CONTINUED.

BY T. PROCTOR HALL.

X-rays are believed to be pulsatory electric waves of the same nature as waves of light, produced by the impulses of charged particles in the kathode stream. Nothing definite is known as to the nature of the differences among rays of high and low penetration, but since rays of high penetration are produced from a kathode stream of high velocity it seems probable that these waves are shorter and of greater relative amplitude than those of low penetration.

In considering the production of x-rays from a Crookes tube the source of the current is of no importance provided the electromotive force and amperage be sufficient. A 16-plate static machine gives scarcely enough current for heavy x-ray work. The static current is also less under the control of the operator than is the current from a well-constructed coil. In other respects the static machine is just as good as a coil, and vice versa. The quantity of current supplied to the x-ray tube, its electromotive force and its impulsiveness are the three features of prime importance. The rapidity of the impulses is a factor of the volume of the x-rays produced. The value of the electrolytic interrupter in the primary circuit of a coil consists in the suddenness and rapidity of the interruptions. Other things being equal, 2,000 interruptions per minute give twice the intensity of x-rays obtained from 1,000 interruptions per minute, tho the penetration of the rays may be the same in the two cases.

In a plain Crookes tube the antikathode is a disk at the center of the bulb. Opposite this is a disk-shaped aluminum kathode. When an impulsive current passes thru the tube, particles of the gas are thrown from the kathode violently against the antikathode, from which they rebound and strike the wall of the tube. The impulsiveness of the impacts depends in part upon the vacuum of the tube, in part upon the style of interruption in the primary current of the coil and in part upon the other resistances in the secondary circuit. Particles of the gas appear to become entangled in the wall of the tube, and after some time the vacuum of the tube becomes higher. Various devices are employed for reducing the vacuum. The only plan available for the plain tube is heating, which must be done gradually and maintained for from fifteen minutes to an hour, and followed by very gradual cooling. The temperature required is 400° or 500° F. After baking, the tube appears to be the same as it was before using, but after repeated use, particularly with a heavy current, a tube is found to have undergone changes which impair its efficiency. These changes are not well understood. They mark the ageing of the tube. The rays produced from an old tube appear to be less homogeneous. Tubes age very rapidly when used with a heavy current and very slowly when used with a light current. Some differences appear to depend upon the kind of gas contained in the tube, but the whole matter of aging needs further investigation.

The regulation of the vacuum is also accomplished by a number of special devices which are more or less efficient, but not perfectly satisfactory. If an operator has only a few tubes it is advisable to

have them of the self-regulating type. Operators who use a large number often prefer the simple tube, from which they are able at any time to select one having the right vacuum for the purpose required.

When the vacuum is low the kathode particles are projected at right angles from its surface. When the vacuum becomes high the particles repel each other more forcibly and come to a focus at a greater distance from the kathode. With a given kathode, therefore, the focal distance of the stream changes with the vacuum of the tube. In x-ray photography, in which it is important that the antikathode should be at the focus of the stream, each tube does good work when the vacuum is within a certain limited range, and gives shadows more or less blurred when the vacuum is either above or below these limits. A tube with adjustable anode has been designed to meet this difficulty. For therapeutic work it is not necessary that the antikathode be at the focus of the stream, nor is it necessary to stop the stray x-rays which are produced from various parts of the tube by stray and reflected kathode rays. For photography these stray x-rays should be eliminated by two lead screens, one having a small hole and placed near the tube, the other having a larger hole and placed close to the object, so as to allow only the required cone of rays to pass thru both holes.

The x-rays are scattered to some extent by almost all substances, but the amount of the scattering in different cases is very different. The rays that strike upon a lead plate are nearly all transformed or destroyed; those that strike upon a silver plate are very largely reflected or diffused; a silver plate may, therefore, be used as an intensifying screen in x-ray photography. If the silver plate is close behind the gelatin film, the effect of the rays upon the film is nearly doubled. The action of the silver appears to be a surface action only. Other substances, such as wood and air, cause a diffusion of the ray thruout every part. For this reason it is advisable in taking a photograph to have as little air as possible between the object to be photographed and the sensitive plate.

X-Ray Diseases of the Skin.*

BY C. H. FESSENDEN, M. D.

I have selected as the subject of this paper the treatment of a class of cases which, while to the x-ray therapist it presents no particular novelty, has been carried out with the routine employment of a tube of high vacuum in all cases, for which, in the beginning of my work at least, there was no precedent, the weight of authority being in favor of the low-vacuum tube and the production of a "mild dermatitis."

My first essay into the field of therapeutic work was in the treatment of a case of recurrent carcinoma of the breast, in which I happened upon one of the few patients whom I have found to be unduly sensitive to the x-ray. In this case the second treatment given with a low tube was followed by such a violent reaction as manifested by elevated tempera-

*Abstracted from a paper read before the National Society of Electro-Therapeutists.

ture and a general erythema of the trunk, not only of the portion rayed, but of the back and sides as well, that I acquired perhaps an undue respect for the mighty force which I had liberated. These circumstances, together with the desire of avoiding the much-dreaded burn, were the determining factors which led to the routine use of the high tube; but as the work progressed it was noticeable that the results were as rapidly obtained as in reported cases of a similar nature wherein use had been made of the low tube and the production of an artificial dermatitis. Latterly the use of the high tube has been adopted as a matter of deliberate choice, and results have been sufficiently prompt and graitfying to warrant a continuation of a method whereby it is possible to assure the patient that there is little or no danger of producing the x-ray burn, a bugbear that is present in the minds of a surprisingly large proportion of persons presenting themselves for treatment, due, no doubt, to an injudicious and sensational secular press. Indeed, the majority of general practitioners are not free from the association of the use of the x-ray with a degree of danger to the patient far in excess of that which presents itself to the mind of one who is familiar with this class of work.

The first application of the ray to abnormal skin conditions was in the case of an eczema occurring in one of my nurses. There were present on the elbows and the extensor aspect of either forearm a number of dry, scaly patches, varying in size from that of a 10-cent piece to that of a silver dollar. These had been present for a number of years, dating back to her school days, at which time they made their first appearance, resulting, apparently, from friction and pressure from the school desk. During a period of two weeks three applications were made to each arm of fifteen minutes' duration, and with the anode one foot from the skin. The result was the entire disappearance of the roughened condition, the only evidence of former disturbance being the persistence for some weeks more of a dusky discoloration upon the sites of former lesions, and even this in time entirely disappeared, leaving an apparently normal integument. This relief continued for some two years or more, but the condition has since recurred following marriage and parturition.

Later on my small apparatus was replaced by a 10-plate machine and a more extended equipment of tubes of the adjustable variety; and with this more powerful apparatus the cases following have been treated during the past year; and, while the number is not large, it represents all cases treated during that time which have not heretofore been reported and which can come strictly under the classification of skin diseases. This is simply mentioned in passing that it may not be presumed that a selection of favorable cases has been made, the desire of this paper being to present an absolutely accurate summary of work done, that the true value of this method of treatment may be shown.

Case 2.—This patient was a domestic who had been suffering for a number of years from eczema of the palms and palmar surface of the fingers. Treatments were given for fifteen minutes at one foot three times a week. The first few treatments relieved the painful condition, and at the end of the second week there was an entire healing of the fissures. Later they recurred in a slight degree, to yield still more readily to treatment, and finally, at the end of three months, eighteen treatments having been given in all, the

case was discharged as apparently cured, and I believe the result to have been permanent, as she gave assurance that, should there be a recurrence, she would again report for treatment, and at the end of some nine months she has not yet so reported.

Case 3.—This case was one of psoriasis occurring in a young married woman, and which had been present for three or four weeks. There were isolated patches upon the upper portion of the chest, also upon the back and posterior aspect of the thighs. Each locality was rayed at one foot for ten minutes. The first application relieved the itching in a measure, and after three treatments, covering a period of eight days, entire relief was obtained and the case discharged.

Case 4.—This was also a case of psoriasis, the patient being a young man of 30 or therabouts and of a decidedly neurotic temperament. The eruption was confined to the back and to the inner aspect of the thighs. At each sitting two exposures of fifteen minutes each were made upon the back and thighs respectively. Five treatments in all entirely removed the disturbing conditions. During the progress of the treatments there was developed one of the chance by-effects which have given a valuable hint in static treatment of neurotic patients. After the first treatment the patient reported that, following the raying of the spinal column, there occurred a particularly buoyant condition and a sense of exhilaration with an increased power of endurance. This result was not entirely temporary, as at the end of treatment there was a sense of general well being, such as had not been experienced for some time. Following up this hint I have, in a number of neurotic cases, employed a five-minute raying of the spine at a distance of eighteen inches with most gratifying results. Granted that this effect may be psychic in a measure, it has seemed to be none the less a beneficial one.

Case 5.—This patient, a blacksmith by trade, was also referred to me for an obstinate attack of psoriasis occurring upon the back. The heavy underclothing and the perspiration incident to his occupation produced an additional irritation and the itching was nearly unbearable. In this case the eruption was confined entirely to the back, which was generally covered with isolated patches. Exposures were made for fifteen minutes at one foot with a high tube. There were given in all six treatments, covering a period of two weeks and a half, at the end of which time the irritation had disappeared and the skin regained normal conditions.

Case 6.—This case was perhaps the most satisfactory of any that have come under my care, inasmuch as it was one which had been pronounced incurable, both by general and special practitioners; indeed, I myself, so he reminded me, told him some twelve years ago that I should have to give him up as a bad job. The patient was a man of middle age, with the following history: He has always been a man of good and regular habits, and up to the time of early manhood had been perfectly free from all abnormal skin conditions. At that time, during a smallpox epidemic, vaccination was followed by a succession of boils in various parts of the body, which in turn were followed by an appearance of eczema, first under the arms and latterly appearing successively upon various parts of the body, leaving one locality as it appeared in a new spot. All sorts of measures, local and consti-

tutional, had been tried during the last thirty years without relief.

The surface of each leg was exposed at a distance of one foot for fifteen minutes. After a few treatments the skin gradually became somewhat more pliable and the irritation less marked. After the first half dozen treatments each sitting was supplemented with an application of the brush discharge from a wooden electrode with a metallic tip. From this time improvement seemed to be more rapid, and at the end of the eighteenth treatment the case was discharged with perfect freedom from all irritation, the skin having assumed its normal thickness and pliability. The only measure, other than electrical, adopted in the treatment of this case was the nightly inunction with plain lanolin. The last treatment was given early in February, and at the present writing there has been no return of abnormal conditions. The notable feature in the treatment of this patient was the more rapid progress after the adoption of the supplementary brush discharge.

Case 7.—This young man, a painter by trade, had been suffering for nearly a year from an obstinate and painful dermatitis of the palms and palmar surfaces of the fingers, following a specific infection. The entire palmer surfaces of both hands were covered with a desquamating epidermis, closely resembling that following scarlatina, and which left behind it a tender red skin, which in turn thickened, cracked and desquamated. There were also numerous deep and painful fissures, bleeding at times. The whole condition was considerably aggravated by the nature of his occupation. Treatment was given three times a week with a tube at one foot from the skin, and relief was soon manifested in the healing of the fissures and cessation of soreness, but desquamation again took place, although leaving this time a more nearly normal surface. Continued treatment finally restored normal conditions after about three months.

One noticeable feature of this case was the entire absence of perspiration, and to overcome this condition during the latter half of the time the following expedient was adopted: An electrode conforming to the shape of the palms was made of two layers of thick tinfoil with a layer of absorbent cotton between the two layers of foil to insure perfect coaptation to the irregularities of surface. By means of this electrode a ten-minute application of the Morton wave current was made at each sitting, resulting in the production of a profuse perspiration, and from the time of the adoption of this measure progress toward recovery became much more rapid.

Case 8.—This case has proved to be one of the most stubborn as well as one of the most satisfactory in its ultimate result. The patient, a young lady teacher, has had from a period dating from girlhood a particularly aggravated dermatitis of the palms, associated with a general anemic condition. She was first referred to me early in the present year, having already had eight x-ray treatments at her home during the Christmas vacation, so that improvement had already begun, and I did not have an opportunity to see the case at its worst. At this time the larger portion of the palmar surface of each hand was covered with a thick, dry, scaly epidermis, with numerous fissures, particularly about the roots of the fingers and in the folds between the thumb and index finger. The condition, aside from being a painful one, was the source of constant annoyance because of the unsightly condition of the hands. Two to

three treatments a week were given with the high tube at one foot from the surface for fifteen minutes. Between January 8th and March 29th eighteen treatments in all were given, and at that time the left hand was entirely well and the right so nearly so that it was hoped that the accumulative effect of the treatments might carry along until normal conditions were established. However, this did not occur, and early in May treatment was resumed, the lesion being confined to a slight roughness in the fold between the thumb and index finger of the right hand with one superficial crack. Treatment twice a week was given through May and the case was discharged June 3d with an apparently normal integument upon both hands, a condition that has not existed since the first onset of the disturbance. As an auxiliary measure during the first period of treatment thin rubber gloves were worn at night and a local application to which she had resorted previous to treatment, consisting of a proprietary preparation, the principal ingredients of which appeared to be tar and glycerine, was employed. Constitutional treatment, the nature of which I am unfamiliar with, was kept up by her regular physician. During the latter period of treatment use of the high-frequency current through a vacuum electrode was made supplemental to the regular raying with apparent advantage. Prognosis is at the present time doubtful, but in any event there is a present freedom from all annoyance, either from a physical or esthetic point of view, and, to the mind of the patient at least, the result has amply warranted the trouble and expense incurred in reaching it. Certainly all methods employed for relief had been futile until this one was employed.

A careful consideration of the method employed in the treatment of these cases would seem to bear out the idea suggested at the last meeting of this body, viz., the twofold action of the ray depending upon the vacuum of the tube employed and its analogy to, if not identity with, the twofold action of the crude and attenuated drug.

In a large number of varying conditions I have depended upon the tonic action of the ray from the high tube, in all cases avoiding production of irritating effect, either from the low tube or the too frequent or too prolonged exposure to the high tube, believing this to be the logical and safe method of treatment. It is generally admitted that abnoraml skin conditions, as well as morbid growths, depend upon a tissue condition of low vitality, yielding to a degree of radiance short of that sufficient for the destruction of normal tissue. Furthermore, there seems to be a primary tonic action of the ray far short of its destructive action which increases functional power in the skin and glandular organs.

Unipolar X-Ray.

BY SAMUEL STERN, M. D., NEW YORK.

Amongst the defects of the Crookes vacuum tubes of today—as they are used for the production of x-rays for therapeutic purposes—perhaps the most glaring is that they must necessarily be connected with both poles of the apparatus. This makes practically a stationary apparatus, does not permit handling with any degree of ease, and often prevents us from using the effective rays on surfaces not easily reached, or those situated in the various cavities of the body.

A number of attempts have been made to construct tubes with long cylindrical projections, which may be used in cavities. These projections are from six to eight inches long, which brings the distance from the anode, where the rays are generated, to the tip of the projection, where they are emitted, up to ten inches or more. As the projection can rarely be passed up directly to the lesion treated, we must allow for several additional inches of distance, reckoned from the source of the ray. Considering that the intensity of exposure is in inverse square ratio to the distance from the source of the ray, we find that, allowing for a distance of about twelve inches, these exposures would have to be greatly prolonged to be effective.

This is a very serious drawback in treating lesions situated in cavities (such as the throat, for instance), where the time of exposure, on account of the inconvenience of keeping the tube in position, is of vital importance. The rays as they are emitted from the cylinder travel in all directions, and it is a very difficult matter to protect the healthy surrounding tissue from their injurious effects.

In experimenting with various forms of high-frequency resonators, I have found that if two Leyden jars are connected by their internal armatures to the two poles of a coil, and the external armatures are connected to a spiral coil having a few strands of thick wire, followed by spirals of fine wire, the current which is derived from the inner extremity of the spiral, when connected with one pole of a Crookes vacuum tube will produce x-rays. This arrangement is very similiar to the apparatus known as the Oudin's resonator.

This method enables us to use vacuum tubes of different sizes and shapes, small enough to be passed into the throat, or any other cavity, with the position of the cathode and anode arranged in a way that the rays can be made to travel in any direction desired. For instance, in the treatment of the larynx, the tube can be passed into the throat over the larynx, the rays being directed downward, so that they will strike the larynx directly without being compelled to travel through any intervening tissue. In treating the oesophagus, these bulbs can be made so as to be attached to a flexible rubber tubing, which may be passed down to the lesion to be treated. While limited time and opportunity have not permitted me to make experiments in regard to passing these bulbs into the stomach itself, I see no reason why an arrangement similar to that devised by Exner* and Einhorn,† for the introduction of radium into the stomach, should not be used as effectively in introducing these bulbs. The fact that they are attached by only one pole, and that the

*Wiener klinische Wochenschrift, January 28, 1904.
†Medical Record, March 5, 1904.

bulbs can be made of any desirable size, should make it a simple matter. Similar methods can also be used for the introduction of these bulbs into the rectum or vagina. The tubes which I have used are simply small vacuum bulbs with a kathode fused into one extremity, and an anode into the other, placed at the usual angle. The kathode extremity of the tube is attached to an insulated glass handle similar to those used in treating by high-frequency currents. This is screwed into a wooden handle, with a wire running thru it, inserted to the extremity of the kathode. The whole arrangement appearing as an ordinary elongated high-frequency tube, with the exception of the infused cathode and anode at its extremity. The anode has no attachment on the outside of the tube, and is merely used to direct the rays toward the point desired. Experiments tend to show that the anode is superfluous, and that the rays can be generated directly on the glass. These bulbs, on account of their minute size, become hot in a short time, but considering that the source of the rays can be brought so closely to the lesions to be treated it is seen that a half-minute exposure at a distance of perhaps one inch from the source of the ray is equal to a number of minutes with the tube at the usual distance. There is some sparking from the surface of the tube, due to the high-frequency currents passing through it, which can be remedied by enclosing the entire tube in rubber, with the exception of the parts through which the rays are desired.—*Med. Record.*

A New Remedy for Appendicitis.

German medical journals are recommending a new and peculiar remedy for appendicitis, the employment of which, it is declared, will obviate the necessity for the use of the knife in the great majority of cases. This remedy consists in walking on all fours twenty minutes four times a day. A contemporary states that this method is not only original, but almost aboriginal. However this may be, the method is certainly worthy of consideration. This method of treatment operates by strengthening the abdominal muscles. When the muscles have relaxed, the bowels become displaced, congested and diseased; the disease extends to the appendix, and thus an inflammation is produced. It is claimed that a well-known German diplomat has been recently cured of chronic appendicitis by this method.

We do not doubt that a person having this disease, if not in an acute stage, may be benefited by getting down on all fours and walking like a dog; but there is something more he must do, also. Though he may with benefit walk like a dog, he must stop gnawing bones like a dog. The dog's method of locomotion is good gymnastics for strengthening the abdominal muscles, but the dog's diet is not adapted to the human constitution. Flesh eating has repeatedly been shown to be an active cause of appendicitis. Persons who do not eat flesh are little subject to appendicitis. This has been clearly proved by statistics collected in Algeria and elsewhere where there is an opportunity for comparison of flesh-eating and non-flesh-eating classes. Undigested fragments of flesh undergoing decomposition in the colon are especially the cause, setting up inflammatory processes in the colon which easily extend to the appendix and even to parts that are more remote.—*Health.*

Animistic Medicine.

The rapid increase of schools, teachers and practitioners of psychic healing indicates more than a mere craze. There is conviction in it. We are not dealing with simply besotted visionaries. They are as rational as we are, and they are as able to bring out conclusive argument as any of us, supported by Holy Writ, logical reasoning and actual good results. They believe in their methods, whereas very many who denounce them are physicians that have little confidence in their own modes of medication. Oliver Wendell Holmes, when he made the wholesale declaration that the entire assortment of drugs was injurious to mankind, voiced the sentiment of the great body of medical men. He would never be the man to deny what the greatest among them have repeatedly asserted, that the current methods employed by them had annihilated no disease, but, on the other hand, had increased the number and often rendered them more deadly.

The modern animistic schools certainly offer us better results than this. They do not profess to go counter to law, but to apply it rationally and normally, consistent with facts and principles which we know and accept. We who have studied medicine and the description of diseases are aware that disorders are often caused by mental emotion; that fear alone will occasion insanity, paralysis, uncontrollable perspiration, cholerina, jaundice, sudden decay of teeth, anemia, skin disease, erysipelas and eczema. Every passion has its peculiar bodily expression. Even false religion makes an unwholesome body. Mind translates itself into corporeal tissue. Why need we demur, then, if we are told that the converse of all this is equally true? It certainly does not seem illogical. If this universe is ruled and held in existence by force and law, then that force and law must be intelligent, and, of course, alive. In such case it may be in the power of individuals to come into harmony and closer communication with the life which creates and sustains the universe. If we can bring rain and lightning from the sky, it is not unreasonable to believe that we can attract, absorb and assimilate vital energy from the great source of life. It may be by faith, which is the willful reaching forth of the mind and consciousness toward that which is higher; or it may be a sober, intelligent self-discipline which brings the individual at one with the forces of nature. Medicines, modes of exercise, regimen and even amulets and ceremonies may be found salutary in the way of effecting such an end.

It may be, as Henry Wood describes, that while all these magnificent results are possible, the great impediment to their attainment generally is because "the average man is inclined to vacate the control of his being, put his body into the keeping of his doctrine and his soul [himself] into the care of his priest or pastor."

Under such circumstances we of the common order must deal with our subjects on the plane where we find them. Till men can subsist on angels' food they must eat bread and the fruits of the earth. So, when they can not communicate, whether by faith or health-giving thought, with higher fountains of health, they will seek for healing medicines for their maladies, and in the fury of intolerable pain will hurry to the dentist for deliverance from an aching tooth. Many of us are too weak of mind for these higher things. Yet to those who would persecute mind-curers and others I would repeat the words imputed to Gamaliel: "If this

counsel or this work be of men it will come to naught; but if it be of God, ye can not overthrow it; refrain, therefore, from these men and let them alone, lest haply ye be found to fight against God." —*Dr. Alexander Wilder, in National Transactions.*

N-Rays.

A discussion before the recent Brit. Ass'n meeting was opened by Lummer, Becquerel having left the room before. Lummer started with the very candid statement that the subject would not have been worth notice but that the French Academy had recently awarded a prize to Blondlot for his work on n-rays. He was aware, of course, of the photographic evidence which had been produced for the existence of n-rays, but thot the exact procedure in these experiments had yet to be carefully scrutinized. He quoted Becquerel's opinion that n-rays have their effect by being reflected into the eye and augmenting the sensitiveness of the retina. As for himself, he was inclined to the opinion that the result was largely physiological, perhaps even in some degree psychological. He described, to illustrate his physiological possibility, an experiment which can be performed with a candle in one's bedroom—though, as he said, the observer's time would be much better occupied in sleep. ' The experiment consists in approaching a candle toward the eye in a line parallel to and to one side of the visual axis. At a certain distance, the pupil begins to undergo contractions, giving the impression of variable luminosity." Of the members present 15 had made experiments to detect n-rays, but only one claimed to have succeeded. The latter described cases in which an observer watching a phosphorescing screen had detected the approach to the back of the screen of pieces of various substances. Rubens remarked that he had once persuaded himself he could trace dimly the motion of his hand behind such a screen, but had found he could not do likewise with other people's hands. He thought that "suggestion" had a great deal to do with the alleged phenomena. Butler gave evidence of the effects of "suggestion" and pointed out in this connection that since Blondlot's measurement of the velocity of Roentgen rays is interlinked to some extent with his n-ray researches, that measurement ought to be carefully repeated. "Thus, it will be seen, the feeling of the meeting was one of cautious, not to say uncharitable, scepticism."—Lond. *Elec.*, Aug. 26.

The Structure of the Atom.—J. J. Thomson (*Phil. Mag.*, March) discusses a mathematical problem suggested by the view that the atoms of the elements consist of a number of negatively electrified corpuscles enclosed in a sphere of uniform positive electrification. The problem discussed by him is the motion of a ring of a given number of negatively electrified particles placed inside a uniformly electrified sphere. The general equations are first developed and are then applied to the cases of two, three, four, five and six corpuscles and the mathematical conditions for the stability of a ring containing more than six corpuscles are developed. The author then applies his mathematical results to the hypothesis that an atom consists of a number of corpuscles moving about in the sphere of uniform electrification, and shows that if the corpuscles are constrained to move in one plane they will arrange themselves in a series of concentric rings, while when they can move about in all directions they will arrange themselves in a series of concentric shells. The

author adds the extremely interesting proof that if we assume such a structure of the atom it will have properties analogous in many respects to those possessed by the atoms of the chemical elements, and that in particular the properties of the atom will depend upon its atomic weight in a way very analogous to that expressed by the periodic law.—*El. World and Eng.*

Pneumatic Cure for Blindness—There has recently been noticed a pneumatic cure for baldness. This is based on the old, old theory that the loss of the hair is caused by a diminished blood supply with resulting atrophy of the hair bulbs. Positively the last thing in the treatment of this affection is what is known as a "capillary chalice." We trust that our denominational friends will not be shocked at this use of the word, but will take the broader view that is derived from the Latin *valix*, meaning a cup, and that it is only within the last half-dozen centuries that the word has been specifically used to designate the communion cup. Besides, to what more noble purpose could an instrument with any name be applied than in the relief of baldness, the deformity of youth, and scarcely to be borne with equanimity in old age. The mechanism of this treatment is simply the old one of cupping.

The chalice is nothing but a hollow rubber pad from which the air can be exhausted, and in this way the circulation of the scalp stimulated so as to produce healthy hair follicles and stimulate the normal growth of the hair. We are left in no doubt as to the efficacy of the treatment, for the advertisement of the company selling the instrument contains a number of illustrations of "before" and "after" treatment. A number of men are shown with remarkably smooth pates, and later we see the same heads covered with hair that would be the envy of any barber in the land. We are informed that the "chalice" does not aim to produce a perfect vacuum, which, of course, nature abhors, but that it is only a partial one. We are gratified at this conservatism on the part of makers of the cup, because a perfect vacuum might result in the loss of a portion of the scalp, and there would be little hope of restoration, as even with this method of stimulating the circulation it could hardly be hoped that the denuded cranium could produce a luxuriant crop of hair.—*Health.*

Medical Electricity.

Electricity used in various forms has come to be a valuable adjunct in medicine and surgery, and undoubtedly will in the course of time be a much more important factor in the treatment of diseases and injuries than it is even now. Medical electricity is as yet but in its infancy. Of the many modes of harnessing electricity to the use of the medical man the production of x-rays is the most conspicuous, and is fast taking its rightful position as an almost indispensable means of diagnosis in certain cases.

The *Hospital* of May 28, 1904, contains a resumé of the latest literature concerning medical electricity. Brock and Stanley Green have pointed out, in the *Quarterly Medical Journal*, that the x-ray tube is of service in the more complete definition of diseased lung in phthisis. They have now had a number of cases to base their deductions upon, and declare that: (1) In no single case in which the physical signs have pointed to disease have the rays failed to detect the mischief; (2) in some cases in which physical signs have

been absent the rays have shown deposits in the lungs, and in these cases physical signs have subsequently been detected; (3) the early diagnosis is certainly helped; (4) that the extent of the disease is in many cases shown to be greater than the physician thinks; (5) that the progress and results of treatment can be watched with greater accuracy.

Chisholm Williams, in the *British Medical Journal*, gives favorable testimony as to the beneficial effects of high-frequency currents in the treatment of phthisis. In 1901 he recorded forty-three cases under treatment, and now of these, three have died of pneumonia, of tuberculous kidney, and of lardaceous disease. He advises that the apparatus be of the most powerful available. In tuberculosis of other parts, joints, etc., the best results have been obtained by general electrification combined with a high vacuum electrode used from the resonator, or the ordinary x-ray discharge. Cases of old-standing tuberculous lesions he states to be very amenable to treatment. In the treatment of lupus he finds the x-ray tube as reliable and to produce as good results as the light treatment. He urges the use of the high vacuum electrodes with a vacuum high enough to produce fluorescence on an x-ray screen. Also the patient should receive on the condensation couch as much as 350 milliampere and upward. In opening the discussion upon the subject of electro-therapeutics in the treatment of malignant diseases, at the annual meeting of the British Society of Electrotherapeutists, Lewis Jones raised numerous questions of the first importance which demand solution ere much advance can be made. Notably is this the case in the matter of what kind of rays are of most advantage—whether the "x-rays," "cathode rays," or a combination of the two. He personally recommends the use of a "medium" tube, and prefers to operate with the anti-cathode red hot. He avoids dermatitis by arranging the exposures suitably, and continues the treatment for three, four or five months.

Alan Jamieson, writing in the *Lancet*, in referring to the employment of hard or soft tubes in x-ray work, states that he has found that weather affects the rays materially, e. g., on cold, raw days reactions more readily occur. Wild, in the *Medical Chronicle*, has grave doubts as to the prophylactic value of the x-rays in preventing recurrence after operation for cancer. A case of splenomedullary leukemia reported in the *Medical Record*, August 22, 1903, has been treated by Nicholas Senn with great success, and other similar cases have been since reported.

On the whole, notwithstanding the many instances in which skin diseases, and even malignant diseases of a superficial nature, have been treated successfully by this means, it is as a diagnostic agent that the x-rays have yielded the most brilliant results. As remarked before, however, we are only upon the threshold so far as the use of electricity in medicine and surgery is concerned.—*Medical Record.*
